NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

JUL 24 1970

REPLY TO
ATTN OF: FA40

MEMORANDUM TO: See attached distribution list

FROM : Chairman, Apollo Software Configuration Control Board

SUBJECT : Latest in Luminary for Apollo 14

On July 22 we had an ersatz Software Control Board Meeting to go over what should be done with Luminary for Apollo 14. The problem that forced us to reopen this program is the error in forward and lateral velocity as displayed on crosspointers during terminal descent. Russ Larson and Don Eyles came down from MIT to explain to us just how this could be fixed in time for a mid-September program release. They also brought a shopping list of other possible changes we could make since we are already breaking open the program. Of these dozen or so possibilities, most of which were minor anomalies with remote chance of occurrence inflight, only two others are to be made. The purpose of this memorandum is to briefly describe the three changes we have agreed to. From this, it should be clear that the basic policy we are attempting to follow is to minimize the number of changes even though MIT was confident they could include them all. In fact, they were anxious to do so for reasons of professional pride and satisfaction.

As noted in a previous memo, the approach MIT prefers for fixing the crosspointer problem is essentially to relocate the Landing Analog Display Routine (R 10) from Don Eyles variable servicer offline assembly into the previously released Luminary assembly which has been through Level 5 testing. This new formulation of R 10 is preferred since it has been running and tested. Furthermore, it streamlines the coding such that it tends to minimize the increase in computer cycle time brought about by the more precise computations needed to eliminate the error. In the package, whether we like it or not, a number of other improvements are accrued. They are:

a. Eliminate the periodic "lurch" in the altitude-rate displayed on the tape meter.

b. Correct the error and excessive granularity of the forward velocity displayed in R1 of noun 60(during P66).

c. Update display of altitude and altitude-rate each 1/4 second instead of every 1/2 second as at present.

d. Begin displaying analog data at TIG - 30 seconds when average-G is turned on instead of waiting for ignition.

e. Eliminate the R10FLAG so that crosspointer displays be available during ascent and aborts as well as descent.

Generally speaking, all of these things can be considered good with the possible exception of the last. The elimination of the R10FLAG makes the crosspointers active during ascent which has been informally requested by some of the crews to assist in monitoring out-of-plane velocity during that critical mission phase. The problem is, though, that during ascent the out-of-plane velocity of interest is inertially oriented whereas during descent it is with respect to the spacecraft. Thus, we are forced to do one of two things to Eyles' R10 - either suppress the display or provide the equations to make them right. In either case, the R10FLAG must be restored. We have left the decision to MIT to be based on whichever is easier.

With respect to cycle time, it is MIT's estimate that the new R10 will decrease our margin by 0.85% out of the total margin of 12%. This does not worry us particularly.

One important item we assigned to Clarke Hackler (GCD) and Clint Tillman (GAEC), was to make sure that the Grumman hybrid facility (FMES) will be available for thoroughly checking this new program. This is absolutely essential since the problem most likely to be encountered will be software/hardware compatibility and that is the only facility the verification can be done with real flight hardware. Initial testing can be done now with Don Eyles offline assembly to verify the formulation. Later we will want to put the flight program through its paces.

Now I would like to go on to the other two changes we approved. The first is to change three fixed memory constants in the ascent propulsion system thrust program (P42) in order to eliminate the 6 fps overburn we would nominally encounter at TPI. The rationale for this change is that it should be very straight forward and it fixes a deficiency we are certain to encounter if the mission goes as planned. The final correction to the program deals with the throttle instability during descent you've heard so much about. We are all convinced the changes made previously, i.e., IMU offset c. g. compensation and erasible memory control system gain changes, are more than adequate. On the other hand, it is recognized that a fixed constant describing the throttle hardware lags is clearly wrong. All of the control systems experts insist that there is no danger but only good things and joy if we change this constant, so it was approved pending a check into possible problems it might create in the initial throttle-down sequence in P63. If we do discover some such problem within the next several weeks we will revert to the old so-called wrong value.

Just one word about the rest of the recognized anomalies we chose not to fix. As noted previously, none is likely to occur. That is, they are all involved in improper crew procedures or re-starts occurring during tiny windows affecting noncritical displays -- things like that. Furthermore, this occurrence is not particularly serious.

Russ Larson presented the following schedule which seemed quite satisfactory to our funny little board:

a. July 31 - all coding complete. At this time an untested program is available for crew evaluation and testing external to MIT.

b. August 17 - Level 3 testing complete, i.e., theoretically the program is ready.

c. September 19 - release for rope manufacture.

Howard W. Tindall, Jr.

FA:HWTindall:mwt 7-24-70